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(54) [Title of the Invention] Apparatus for the Measurement of Differential Pressure Equipped with a Mechanism for the Diagnosis of Clogging of a Pressure Conducting Pipe

[57] [Abstract]

[Purpose]

To provide an apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe which is capable of detecting a clogging state of a pressure conducting pipe, can improve the reliability of pressure detection and can be easily and simply maintained.

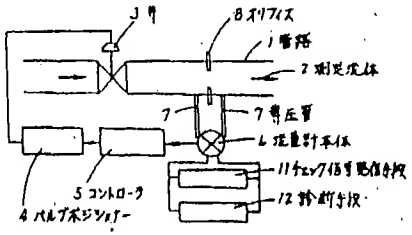
[Constitution]

An apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe by which to detect a differential pressure through a pressure conducting pipe / pipes;

said apparatus for the measurement of differential pressure equipped with



a mechanism for the diagnosis of clogging in a pressure conducting pipe characterized in that it is also equipped with a check signal transmitting means by which to convert an output signal of the apparatus for the measurement of a differential pressure from a measured signal into a check signal at a required time set in said apparatus for the measurement of a differential pressure and a diagnosis means by which to detect a variation in differential pressure based on the above- mentioned check signal set in the above- mentioned apparatus for the measurement of a differential pressure, to compare it with a pre- determined standard value, to detect a clogging state /states of the above- mentioned pressure conducting pipe /pipes, and to generate a detection signal.



Key 1 pipe path, 2 object for measurement, 3 valve, 4 valve positioner 5 controller, 6 flow meter body 7 pressure conducing pipe, 8 orifice, 11 check signal generating means, 12 diagnosis means

[What we claim is]

[Claim 1]

An apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe by which to detect a differential pressure through a pressure conducting pipe / pipes;

said apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe characterized in that it is also equipped with a check signal transmitting means by which to convert an output signal of the apparatus for the measurement of a differential pressure from a measured signal into a check signal at a required time set in said apparatus for the measurement of a differential pressure,

and a diagnosis means by which to detect a variation in differential pressure based on the above- mentioned check signal set in the above-mentioned apparatus for the measurement of a differential pressure, to compare it with a pre- determined standard value, to detect a clogging



state /states of the above- mentioned pressure conducting pipe /pipes, and to generate a detection signal.

[Detailed Explanation of the Invention]

[0001]

[Utilization Fields in the Industry]

The present invention relates to an apparatus for the measurement of a differential pressure equipped with a diagnosis mechanism of clogging in a pressure conducting pipe /pipes which is capable of detecting clogging of a pressure conducting pipe, can improve the reliability of pressure detection and can be easily and simply maintained.

[0002]

[Conventional Technology]

In Fig.5 is shown a drawing by which to explain the constitution of a conventional example which has generally been used for many years. For example, it is shown in "Kogyo Keisoku Handbook (Handbook of Industrial Instrumentation)" (Volume on Pneumatic Instrumentation), edited by Yokokawa Electric Co., Ltd., published by Tokyo Electric

College Publication, date published December 10, 1966, page 2 Fig. 1. 3.

[0003]

In Fig. 5, 1 is a pipe path through which a fluid to be measured 2 flows. 3 is a valve by which to control the flow volume of the fluid to be measured, and 4 is a positioner by which to control the degree of opening of the valve 3. 5 is a controller by which to control a positioner 4.

[0004]

6 denotes a flow meter body by which to detect the flow volume of the fluid to be measured which has been controlled by the valve 3 and to send a detection signal to the controller 5. And in this case, use is made of a differential pressure transmitter. 7 is a pressure conducting pipe by which to transmit the pressure of the fluid to be measured 2 to the flow meter body 6. 8 is an orifice.

[0005]

In the above- mentioned constitution, when a fluid to be measured 2 flows through the pipe path 1, the flow meter body 6 measures the flow volume of the fluid to be measured 2. The signal of the measurement of the flow



volume from the flow meter body 6 is sent to the controller 5, where it is compared with a target value, an adjustment signal is sent to the valve positioner 4, and thus the valve 3 may be opened or closed.

[0006]

[Tasks which the Invention Tries to Solve]

However, with such an apparatus, even when the pressure conducting pipe 7 is clogged and some abnormality takes place in the pressure conducting pipe 7, it is difficult to detect the abnormality in many cases, although it is possible to detect such an abnormality in a case in which there takes place a large variation to the extent that the output of the flow meter body 6 reaches the limit of the meter or beyond, or in a case in which an inspection such as a regular inspection is carried out.

[0007]

In order to prevent these abnormalities from taking place before the generation of an output abnormality, it is necessary to predict it from a variation in output in an empirical manner, or to find a clogging state by a regular inspection by an operator, etc. In view of safety, it is necessary

to have frequent regular inspections, and frequent inspections have problems of requiring time and labor. In addition, there has been a problem in that it can not cope with sudden clogging.

[0008]

The present invention has been achieved in order to solve the above-mentioned problems of the conventional technology. The purpose of the present invention is to provide a differential pressure measuring apparatus which is capable of constantly observing a clogging state of a pressure conducting pipe and can sound an alarm in a case in which the clogging in a pressure conducting pipe exceeds a pre- determined level.

[0009]

That is, the purpose of the present invention is to provide an apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe which is capable of detecting clogging of a pressure conducting pipe, can improve the reliability of pressure detection and can be easily and simply maintained.



[0010]

[Means by which to Solve the Task]

In order to achieve this purpose, in the present invention, there is constituted an apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe by which to detect a differential pressure through a pressure conducting pipe / pipes;

said apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe characterized in that it is also equipped with a check signal transmitting means by which to convert an output signal of the apparatus for the measurement of a differential pressure from a measured signal into a check signal at a required time set in said apparatus for the measurement of a differential pressure and a diagnosis means by which to detect a variation in differential pressure based on the above- mentioned check signal set in the above- mentioned apparatus for the measurement of a differential pressure, to compare it with a pre- determined standard value,

to detect a clogging state /states of the above- mentioned pressure conducting pipe /pipes, and to generate a detection signal.

[0011]

[Actions]

With the above- mentioned constitution, when making a diagnosis of clogging in a pressure conducting pipe, an output signal of the apparatus for the measurement of a differential pressure is converted from a measured signal to a check signal and it is output in the check signal transmitting means. In the diagnosis means, a variation in differential pressure based on the above- mentioned check signal is detected, and is compared with a pre- determined standard value, a clogging state / states of the above- mentioned pressure conducting pipe / pipes is /are detected, and a detection signal is output. In the following, we shall explain the present invention in detail by referring to some examples embodying the present invention.

[0012]

[Examples Embodying the Invention]



Fig. 1 is a drawing by which to explain the constitution of the major section of one example embodying the present invention. In the drawing, the constituting elements of the identical signs as those in Fig. 5 performs the identical functions. In the following, we shall explain only the sections which are different from Fig. 5.

[0013]

In the drawing, 11 is a check signal transmitting means provided in the flow meter body 6 by which to convert an output signal of the flow meter body 6 from a measured signal to a check signal β at the required time. 12 is a diagnosis means provided in the flow meter body 6 by which to detect a variation in differential pressure based on a check signal, to compare it with a pre- determined standard value, to detect a clogging state / states of a pressure conducting pipe /pipes and to output a detection signal.

[0014]

In making a diagnosis of clogging in the pressure conducting pipe 7 with the above- mentioned constitution, in the check signal transmitting means

11, an output signal α of the flow meter body 6 is converted into a check signal β from a measured signal which is generally being sent out, and then it is output. In the diagnosis means 12, a variation in differential pressure based on the check signal β is detected, and is compared with a pre- determined standard value, a clogging state / states of the pressure conducting pipe /pipes 7 is/ are detected, and a detection signal is output.

[0015]

That is, the clogging diagnosis is made at a regular cycle T as shown in Fig. 2 (a). In addition, it is a matter of course that it may be made at an arbitrary time. Here the ordinate means an output volume, and the abscissa is a time axis. The same applies to any case below in which a graph is shown.

[0016]

Fig. 2 (b) is an enlarged view of Fig. 2 (a), and in this case, it is indicated that the check signal has changed β to the lower direction than the actual output. With respect to the check signal, the controller 5 varies in the direction to increase the flow volume of the fluid to be measured 2, as



shown in Fig. 2 (c). The mode of the change in this case becomes different by a set value for the PID operation,

[0017]

Since the control quantity of the controller 5 varies, as shown in Fig. 2 (d), the flow volume Q itself varies with it. Between the flow volume Q and the differential pressure ΔP, there hold the following formula, and therefore it the flow volume Q changes, the differential pressure ΔP before and after the orifice 8 also varies.

$$Q = K (\Delta P)^{1/2} \qquad (1)$$

where K is a proportional constant.

Therefore, when the pressure conducting pipe 7 is normal, as shown in Fig. 2 (e), the differential pressure which is to be input to the flow meter body 6 varies depending on a variation in flow volume.

[0018]

In a case in which both pressure conducting pipes 7 both on the high pressure side and the low pressure side, as shown in Fig. 2 f, the differential pressure just before and after the orifice 8 is not transmitted to

the flow meter body 6. In a case in which only one of the pressure conducting pipes 7 on one side is clogged, as shown in Fig. 2 g, since the differential pressure is transmitted only on one side, the variation quantity of the differential pressure transmitted to the flow meter body 6 becomes small compared with a normal time.

[0019]

In a case in which the pressure conducting pipe 7 is being clogged, as shown in Fig. 2 (h), an output response may be delayed, or a variation quantity may be come small. Therefore, it becomes possible to detect whether or not the pressure conducting pipe 7 is not clogged and it is in a normal state, by making a comparison between how a response is input to the flow meter body 6 in a case in which the output of the flow meter body 6 is varied, and the case of a normal time.

[0020]

As an example of judgment of whether or not the pressure conducting pipe 7 is not clogged and it is in a normal state, it is for example done in the following manner. That is, it is judged by whether or not an input



differential pressure variation quantity y t seconds after varying the output of the flow meter body 6 is smaller or larger than the set threshold x. Fig. 3 (a) shows a state in which the output value $\alpha$ of the flow meter body 6 is changed $\beta$, for the sake of checking.

[0021]

Fig. 3 (b) shows the input differential pressure of the flow meter body 6 at the corresponding normal time when the output value $\alpha$ of the flow meter body 6 is changed $\beta$. Fig. 3 © shows a case in which the input differential pressure variation quantity y after t seconds is small compared with the set value x, and the judgment becomes "No", and for example, an alarm signal is output from the diagnosis means 12.

[0022]

Fig. 3 (d) shows a case in which the input differential pressure variation quantity y after t seconds is large compared with the set value x, and the judgment becomes "good", and it is judged by the diagnosis means 12 that the pressure conducting pipe 7 is not clogged. In the above, the above- mentioned x and t are set to appropriate values from the state of

the input differential pressure variation quantity at the normal time.

[0023]

As an example of an alarm output from the diagnosis means 12, it may be done as follows, for example.

(1) In a case of an apparatus for the measurement of a differential pressure which is equipped with an LCD display, it is possible to display on the LCD an error number which has been decided in advance, or to flash a display.

[0024]

(2) An output current is varied according to a rule which has been set in advance. As a result of this, it becomes possible to avoid a possibility of carrying out an erroneous control by clogging of the pressure conducting pipe 7 because the flow meter body 6 is provided with a function to self-detect or predict clogging of the pressure conducting pipe 7.

[0025]

Fig. 4 is a drawing by which to explain the constitution of the major section of another example embodying the present invention. In this



example embodying the present invention, 21 is a flow meter body, which contains in it a PID control function. Therefore, it does not require a controller 5. As to the operations thereof, since the flow meter body 21 is an entity in which the controller 5 is contained in the flow meter body 6 itself in the example embodying the present invention which is shown in Fig. 1, it operates in the same manner as the one shown in Fig. 1.

[0026]

[Effects of the Invention]

As explained above, in the present invention, we have constituted an apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe by which to detect a differential pressure through a pressure conducting pipe / pipes;

said apparatus for the measurement of differential pressure equipped with a mechanism for the diagnosis of clogging in a pressure conducting pipe characterized in that it is also equipped with a check signal transmitting means by which to convert an output signal of the apparatus for the

measurement of a differential pressure from a measured signal into a check signal at a required time set in said apparatus for the measurement of a differential pressure,

and a diagnosis means by which to detect a variation in differential pressure based on the above- mentioned check signal set in the above-mentioned apparatus for the measurement of a differential pressure, to compare it with a pre- determined standard value, to detect a clogging state /states of the above- mentioned pressure conducting pipe /pipes, and to generate a detection signal.

[0027]

As a result of this, it becomes possible to avoid a possibility of carrying out an erroneous control by clogging of the pressure conducting pipe 7 because the flow meter body 6 is provided with a function to self- detect or predict clogging of the pressure conducting pipe 7.

[0028]

Therefore, with the present invention, it is possible to realize an apparatus for the measurement of differential pressure equipped with a mechanism



for the diagnosis of clogging in a pressure conducting pipe which is capable of detecting a clogging state of a pressure conducting pipe, can improve the reliability of pressure detection and can be easily and simply maintained.

[Simple Explanation of the Drawings]

[Fig. 1] is a drawing by which to explain the constitution of the major section of one example embodying the present invention.

[Fig. 2] is a drawing by which to explain the operations of Fig. 1.

[Fig. 3] is a drawing by which to explain the operations of Fig. 1.

[Fig. 4] is a drawing by which to explain the constitution of the major section of another example embodying the present invention.

[Fig. 5] is a drawing by which to explain the constitution of a conventional example which has been generally used for many years.

[Explanation of the Symbols]

1 pipe path

2 fluid to be measured

3 valve

4 valve positioner

5 controller

6 flow meter body

7 pressure conducting pipe

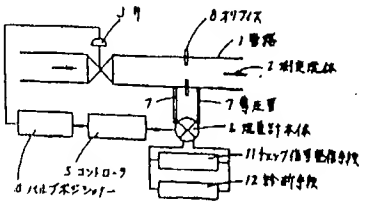
8 orifice

11 check signal transmitting means

12 diagnosis means

21 flow meter body

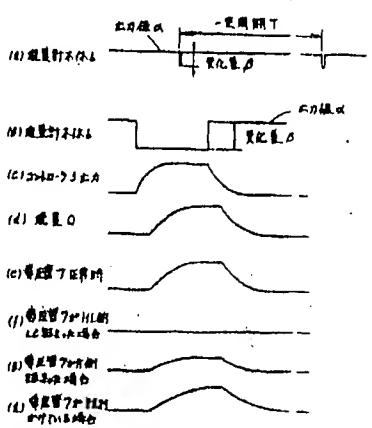
[Fig. 1]



Key 1 pipe path, 2 fluid to be measured, 3 valve, 4 valve positioner 5 controller, 6 flow meter body 7 pressure conducing pipe, 8 orifice, 11 check signal generating means, 12 diagnosis means

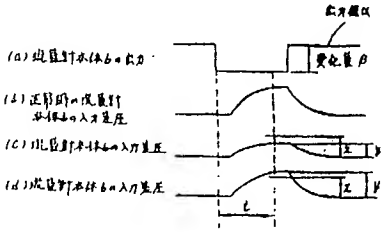


Fig. 2



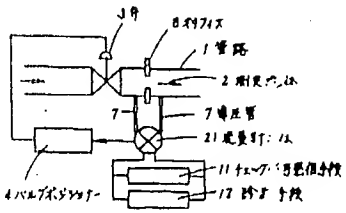
key (a) Flow meter body 6, (b) Flow meter body 6, © Output of controller 5, (d) Flow volume Q, (e) At the time when the pressure conducting pipe 7 is normal, (f) Case in which both pressure conducting pipes 7 are clogged on both H and L sides, (g) Case in which the pressure conducting pipe 7 is clogged on the H side, (h) Case in which the pressure conducting pipe 7 is being clogged, α output value, β variation quantity, T constant cycle

[Fig. 3]



Key (a) Output of the flow meter body 6, (b) Input differential pressure of the flow meter body 6 at the normal time, © Input differential pressure of the flow meter body 6, (d) Input pressure difference of the flow meter body 6, α output value, β variation quantity

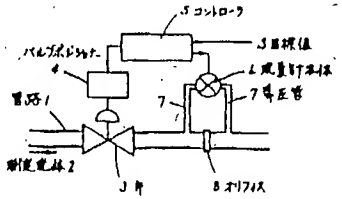
[Fig.4]



Key 1 pipe path, 2 fluid to be measured, 3 valve, 4 valve positioner 5 controller, 6 flow meter body 7 pressure conducing pipe, 8 orifice, 11 check signal generating means, 12 diagnosis means



[Fig. 5]



Key 1 pipe path, 2 fluid to be measured, 3 valve, 4 valve positioner 5 controller, 6 flow meter body 7 pressure conducing pipe, 8 orifice, S target value